Final Technical Report of AASERT Grant F49620-92-J-0327

15 June 1992 - 14 June 1995

Craig T. Bowman
Department of Mechanical Engineering
Stanford University

Project Objective:

This project is directed toward obtaining a more fundamental understanding of mixing and chemical reaction in supersonic flows. The research effort comprises three inter-related elements: (1) an experimental study of mixing and combustion in a supersonic plane mixing layer; (2) development of laser-based diagnostics for high-speed flows; and, (3) simulations of compressible reacting flows.

Accomplishments:

Four doctoral students were supported, in part, by this grant. Two of these students were involved in the development of planar laser-induced fluorescence (PLIF) techniques for measurement of supersonic flow parameters. Two of the students were involved in the experimental studies of mixing and combustion in supersonic flows. Specific accomplishments include the development of a temporally-resolved two-dimensional velocity measurement technique based on PLIF of NO and the OH radical, measurement of the structure of supersonic reacting mixing layers, and investigation of mixing enhancement in non-reacting supersonic flows.

All students made satisfactory progress toward completing the requirements for the Ph.D. degree. Two students have completed their Ph.D. programs, and one student is nearing completion.

Publications:

The following publications, describing the work of the students, were published during the three-year period of this grant.

M. P. Lee, B. K. McMillin, J. L. Palmer and R. K. Hanson, Two-Dimensional Imaging of a Transverse Jet in Supersonic Crossflow, J. Prop. and Power **8**, 729-735 (1992).

J. M. Seitzman, J. L. Palmer, A. L. Antonio, R. K. Hanson, P. A. DeBarber and C. F. Hess, Instantaneous Planar Thermometry of Shock-Heated Flows using PLIF of OH, AIAA Paper 93-0802, 31st AIAA Aerospace Sciences Meeting, Reno, Jan. 1993.

B. K. McMillin, J. L. Palmer and R. K. Hanson, Temporally Resolved, Two-Line Fluorescence Imaging of NO Temperature in a Transverse Jet in a Supersonic Cross Flow, Applied Optics **32**, 7532-7545 (1993).

J. L. Palmer and R. K. Hanson, PLIF Measurements of Temperature and Velocity in a Reacting Supersonic Free Jet, AIAA Paper 94-0618, 32nd AIAA Aerospace Sciences Meeting, Reno, NV, January 1994.

M. F. Miller, T. C. Island, J. M. Seitzman, M. G. Mungal, C. T. Bowman and R. K. Hanson, Compressibility Effects in a Reacting Mixing Layer, AIAA Paper 93-1771, 29th AIAA/SAE/ASME/ASEE Joint Propulsion Conference, Monterey, CA, July 1993.

M. F. Miller, T. C. Island, J. M. Seitzman, M. G. Mungal, C. T. Bowman and R. K. Hanson, An Experimental Investigation of Supersonic Reacting Mixing Layers, AIAA Paper 94-0823, 32nd AIAA Aerospace Sciences Meeting, Reno, NV, January 1994.

J. M. Seitzman, M. F. Miller, T. C. Island and R. K. Hanson, Double-Pulsed Imaging Using Simultaneous Acetone/OH PLIF for Studying the Evolution of High-Speed, Reacting Mixing Layers, Twenty-Fifth Symposium (International) on Combustion, The Combustion Institute, pp. 1743-1750, 1994.

B. Yip, M. F. Miller, A. Lozano and R. K. Hanson, A Combined OH/Acetone Planar Laser-Induced Fluorescence Imaging Technique for Visualizing Combustion Flows, Expts. In Fluids **17**, 330-336 (1994).

J. L. Palmer and R. K. Hanson, Single-Shot OH PLIF Thermometry in a Reacting, Supersonic Free Jet, AIAA Paper 95-0517, 33rd AIAA Aerospace Sciences Meeting, Reno, NV, January 1995.

J. L. Palmer and R. K. Hanson, Shock Tunnel Flow Visualization using Planar Laser-Induced Fluorescence Imaging of NO and OH, Shock Waves **4**, 313-323 (1995).

AFOSR-TR-95

0533

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	14 July 1995	Final Technical 15 Jun 92 - 14 Jun 95

4. TITLE AND SUBTITLE
(U) (FY91 AASERT) Graduate Student Support in Supersonic Diagnostics and Flow

5. FUNDING NUMBERS
PE - 61103D
PR - 3484
SA - S1
G - F49620-92-J-0327

6. AUTHOR(S)
Craig T. Bowman

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Stanford University
Stanford CA 94305-3032

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFOSR/NA
110 Duncan Avenue, Suite B115
Bolling AFB DC 20332-0001

NA

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
F49620-92-J-0327

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Four doctoral students were supported, in part, by this grant. Two of these students were involved in the development of planar laser-induced fluorescence techniques for measurement of supersonic flow parameters. Two of the students were involved in the experimental studies of mixing and combustion in supersonic flows. Specific accomplishments included the development of a temporally-resolved two-dimensional velocity measurement technique based on planar laser-induced fluorescence of nitrous oxide and the hydroxyl radical, measurement of the structure of supersonic reacting mixing layers, and investigation of mixing enhancement in non-reacting supersonic flows.

14. SUBJECT TERMS	15. NUMBER OF PAGES
laser spectroscopy, laser-induced fluorescence, shear layer, combustion, supersonic, scramjet	3
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL